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II. Solution by Professor J. F. W. SCHEFFER, A. M., Hagerstown, Maryland.

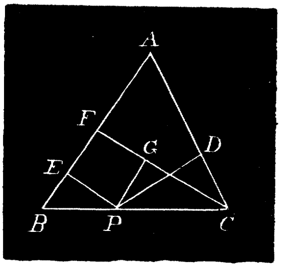
Denote the circles whose radii are a, b, and c respectively by O, O'; O'', and P the point of intersection of the tangents common to O, O' and to O', O''. Since P is in the tangent common to O and O', the powers of P with reference to these two circles are equal, and as much as P is in the common tangent of O' and O'', its powers to these two circles are equal; consequently, its powers with ref. to O and O'' being equal, P must lie in the tangent common to O and O''. It is, in fact, the radical center of the three radical axes. Denoting the required distance by x, we have for the areas of the three triangles $OO'P$, $OO''P$, $O'O''P$, respectively, $\frac{1}{2}x(a+b)$, $\frac{1}{2}x(a+c)$, $\frac{1}{2}x(b+c)$; and since the area of $\triangle OO'O''$, whose sides are $a+b$, $a+c$, $b+c$, is $=\sqrt{abc(a+b+c)}$, we have $\frac{1}{2}x(a+b)+\frac{1}{2}x(a+c)+\frac{1}{2}x(b+c)=\sqrt{abc(a+b+c)}$, whence $x=\frac{\sqrt{abc(a+b+c)}}{a+b+c}=\sqrt{\frac{abc}{a+b+c}}$.

Q. E. D.

5. Proposed by ADOLPH BAILOFF, Durand, Wisconsin.

If from a variable point in the base of an isosceles triangle, perpendiculars are drawn to the sides, the sum of the perpendiculars is constant and equal to the perpendicular let fall from either extremity of the base to the opposite side.

1. Solution by ROBERT J. ALEY, A. M., Professor of Mathematics in the Indiana State University, Bloomington, Indiana.



PG is drawn paralell to AB.

$PE=FG$.

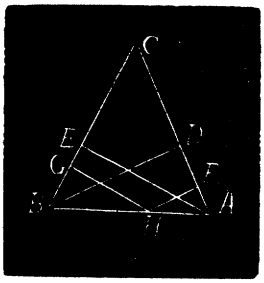
$PD=GC$, because $\triangle$ GPC and $\triangle$ PDC have the same hypotenuse PC and the acute angle GPC of the one equal to the acute angle DCP of the other. $\therefore$ $PE+PD=FG+GC=FC$.

II. Solution by Hon. JOSIAH H. DRUMMOND, LL. D., Portland, Maine;

Connecting the vertex of the triangle with the variable point, wherever in the base it may be, the triangle is divided into two triangles whose area is one-half the product of the perpendicular and one of the equal sides of the triangle respectively; hence, the area of the original triangle is equal to one-half the product of one the equal sides by the sum of the two perpendiculars. Hence the sum of the perpendiculars equals the perpendicular from the extremity of the base to the opposite side.

Solved similarly by *P. H. Philbrick*

III. Solution by A. L. FOOTE, C. E., No. 80, Broad St., New York, and ALBERT J. ROBINSON, Pottersburg, Ohio.



The triangle being isosceles, the angles CAB CBA and are equal, consequently BD and AE are equal, and because they are at right angles to the sides AC and BC, then HF and HG which are at right angles to AC and BC are parallel, HF to BD and HG to AE; whence, $BH: AB:: GH: AE$ and $AH: AB:: FH: BD$. Therefore, $AH+BH: 2AB:: GH+FH: AE+BD$. But $BD=AE$ and $AH+BH=AB$, then we have $AB: 2AB:: GH+FH: 2AE$ or

$GH+FH=\dfrac{2AE\times AB}{2AB}$ or $=AE$. The same result would follow wherever, in the base AB, the point H is taken so that $FH+HG$ is constant and equal to AE or BD. Q. E. D.

This problem was also solved in an elegant manner by *J. A. Calderhead, Charles E. Myers, Professor G. B. M. Zerr, P. S. Berg,* **and** *Professor H. C. Whitaker.*

PROBLEMS.

21. Proposed by CHARLES E. MYERS, Canton, Ohio.

A cistern 6 feet in diameter contains 3 inches of water. If a cylinder, four feet long and one foot in diameter, be laid in a horizontal position on the bottom, to what height will the water rise?

22. Proposed by J. A. TIMMONS, St. Marys, Kentucky.

Given, the perimeter of a triangle $=100(2s)$, the radius of the inscribed circle $=9(r)$, and the radius of the circumscribed circle $=20(R)$; it is required to find (1) the sides of the triangle, (2) the radius of the circle circumscribing the triangle formed by bisecting the exterior angles of the original triangle, (3) the area of the triangle thus formed; all in terms of R, r, s.

23. Proposed by E. L. PRATT, Tecumseh, Nebraska.

The ordinate of the point P of an ellipse is produced to meet the circle described on the major axis as diameter at Q. CQ, the straight line joining Q and the center of the ellipse, is tangent to the circle described on the focal radius of P as diameter.

If θ is the excentric angle of P prove that

$$\sin 2\theta=\frac{2(2a+b)\pm4\sqrt{a(a+b)}}{a-b}$$

24. Proposed by T. W. PALMER, Professor of Mathematics in the University of Alabama.

Two right triangles have the same base, the hypotenuse of the first is equal to 60, of the second 40. The point of intersection of the two hypotenuses is at the distance 15 from the base. Find the length of the base.

25. Proposed by L. B. FRAKER, Weston, Ohio.

The sides of a quadrilateral board are $AB=7$ inches, $BC=15$ inches, $CD=21$ inches, and $DA=13$ inches; radius of inscribed circle is 6 inches. (1) What are dimensions of the largest rectangular board that can be cut out of the given board, (2) largest square, (3) largest equilateral triangle? (Please solve without use of the calculus.)

26. Proposed by J. F. W. SCHEFFER, A. M., Hagerstown, Maryland.

$ABCD$ represents a rectangle, and $ABEF$ a trapezoid which is perpendicular to the rectangle, both figures having the side AB common to each other, and ADF and BCE forming two right triangles perpendicular to the rectangle $ABCD$. To determine the conoidal surface $CDFE$ so as to satisfy the condition that any plane laid through AB will intersect it in a straight line. Also find volume of the solid thus formed.

27. Proposed by ADOLPH BAILOFF, Durand, Wisconsin.

A line BE, that bisects an angle exterior to the vertical angle of an isosceles triangle is parallel to the base AC.